Nuclear technology

11:00 11/22/2017 (updated: 08:32 03/03/2020) 3072

Yuri Trutnev: the creation of nuclear weapons is a special creativity

© Photo: Russian Federal Nuclear Center

Read ria.ru in Новости Дзен

On November 22, 1955, the first full-fledged domestic hydrogen bomb RDS-37 was successfully tested at the Semipalatinsk test site in the Soviet Union. It became the prototype for future munitions that became the basis of Russia's nuclear shield and ensured strategic parity with the United States and, ultimately, peace. According to experts, a key contribution to those successes was made by a then young employee of the country's nuclear weapons "headquarters" - Design Bureau-11 (now the Russian Federal Nuclear Center - All-Russian Research Institute of Experimental Physics, Sarov) - Yuri Trutnev.

On November 2 of this year, the first deputy scientific director for advanced research of the RFNC-VNIIEF, Academician Trutnev, turned 90 years old. Russian President Vladimir Putin presented the legendary scientist with the Order of Merit for the Fatherland, first degree, in the Kremlin. Yuri Trutnev spoke in an interview with RIA Novosti about how domestic thermonuclear charges were created, how the experience of the Soviet nuclear project can help develop new areas of defense research and what young people need to succeed in science. Interviewed by special correspondent Vladimir Sychev.

- Yuri Alekseevich, in your opinion, despite the development of new types of weapons, such as hypersonic weapons, is there still a need for the existence of nuclear weapons?

- Of course, it remains, and the need is not just for its existence, but also for its improvement. We are doing this in our nuclear center. But not only this, but also other things that, let's say, would help nuclear weapons hit the enemy.

- The leading powers possessing nuclear weapons observe the ban on their testing. Couldn't the quality of equipment for nuclear forces decrease under such conditions?

- I think there is nothing wrong with the fact that tests are prohibited - we have accumulated the necessary experience, we have accumulated charges that we can make. New carriers are also being created on which existing charges can be placed.

- Your students and colleagues unanimously say that you maintain great efficiency and great curiosity in science. Is it possible, to the extent possible, to tell you what things you are working on now?

— From the very beginning, I worked for the country's defense capability. And now this is my most important task. But it is probably still inappropriate to say in detail what tasks I am currently doing.

- How did you manage to come up with the ideas that formed the basis of our modern thermonuclear weapons?

- How did it all start? After the first Soviet atomic charge was made and tested in 1949, both the Americans and our country began to develop thermonuclear charges. On August 12, 1953, our charge, the so-called puff, was tested, the design of which - an atomic charge surrounded by layers of thermonuclear "fuel" and uranium-238 - was proposed by Andrei Sakharov. But it was not a thermonuclear charge in the modern sense. The fact is that a charge can be considered thermonuclear if more than half the energy during its explosion is released due to thermonuclear reactions of fusion of nuclei of hydrogen isotopes - deuterium and tritium, and not due to fission reactions of uranium or plutonium nuclei. From this point of view, the ''Sakharov layer'' was an atomic charge with the so-called thermonuclear enhancement, which produced a flow of neutrons that contributed to the fission of uranium-238 nuclei. This made it possible to increase the charge power to 400 kilotons. For comparison, our first atomic charge yielded about 20 kilotons.

Our task was to increase the charge power to the megaton level. But at some point it became clear that, due to the design features of the ''puff'', this could not be achieved.

© RIA Novosti / Sergey Mamontov | Go to media bank

- What were the main difficulties?

"We had to figure out how to effectively compress large quantities of thermonuclear "fuel"—lithium-6 deuteride. After all, thermonuclear reactions occur at colossal temperatures and pressures. So, conventional explosives were not suitable for providing the required compression, or as we call implosions.

It was Abraham Zavenyagin, one of the leaders of our nuclear industry at that time, who first proposed using the energy of an explosion of atomic charges for this purpose. He said - take a thermonuclear charge, surround it with atomic charges, explode them at the same time, they will compress it. And this was, of course, not a solution to the problem, but a hint of what to do. This idea was later developed by our theorist Viktor Davidenko. In fact, he proposed a scheme for the so-called two-stage charge - a casing in which there were spatially separated atomic and thermonuclear units. The energy from the explosion of the primary atomic stage would be used to ignite thermonuclear reactions in the secondary stage. Our outstanding specialists Yakov Zeldovich and Andrei Sakharov had great hopes for this so-called nuclear implosion scheme.

- What ideas did you have?

- I'll tell you. I worked a lot on the theory of efficiency of atomic charges. I knew that when they explode, a lot of energy comes out in the form of x-rays. And I began to think about how to coat the thermonuclear charge with a light substance - a "coating", these could be low-number chemical elements that have very good thermal conductivity, and with the help of X-ray radiation from the explosion of the primary atomic charge, the "coating" heat. In this case, its substance would evaporate outward, towards the radiation, and as a result, as during the movement of a rocket, a reactive impulse would be created, directed into the secondary charge and creating the pressure necessary for effective compression of the thermonuclear "fuel".

But how was it possible to ensure a uniform, symmetrical effect of radiation on the spherical surface of a thermonuclear charge with "coating"? I'm stuck here.

And at some point in the spring of 1954, Zeldovich comes from Moscow and says: "I know what to do! Let's release radiation like this." And then he drew a diagram of how the principle of radiation implosion could be implemented. And I immediately realized that my idea was suitable for this.

That same day I came to Sakharov and said: "Andrei Dmitrievich, Yakov Borisovich proposes to act with radiation in such and such a way. And I propose to surround the thermonuclear charge with a light substance and use it to compress it." And they stopped there.

© RIA Novosti / Andrey Zolotov | Go to media bank

- On your proposal?

- No, this is not just my proposal. This is a proposal from three people - Zeldovich, Sakharov, Trutnev. Zeldovich proposed exactly how to direct X-ray radiation, Sakharov showed that this radiation is not absorbed by the walls of the casing, but remains in it and therefore a uniform effect on the surface of the thermonuclear unit can occur. And my idea is a "coating" of a light substance to convert radiation into the required pressure. I remember how I came up with my idea, but now I can only guess how they came up with their ideas.

But, of course, everything had to be calculated first, to show whether anything would work out. This is not a bicycle - you connect two wheels and you ride. The temperatures here are tens of millions of degrees. The pressure is incredible. Times... We had a measurement of time in instants, and one ten-millionth of a second was taken as one instant. And the entire explosion process occurs in a few tens of moments. Can you imagine how small these times are?

- How long did the calculations and creation of the charge take?

— I can say that the idea appeared in the spring of 1954, and the test took place in November 1955. And all this time there was frantic work going on. Young specialists joined her - those who came to our center in 1951, including me. And each one looked at a certain point in the process. And as a result, our first real thermonuclear charge, RDS-37, was actually designed. The basic principle of its structure is not hidden now.

- How was his test on November 22, 1955?

— We stood 40 kilometers from the epicenter of the explosion. Of course, we had dark glasses to protect our eyes. Flash. We jumped up and started shouting: "Victory!" - and then the shock wave came. How we were shaken! We got hit, we jumped up - and then there was a second wave reflected from the ground. Everyone fell again.

The most important thing is that we have an estimated yield of 1.6 megatons. The charge power, however, was initially halved because the test site was not designed for high-power explosions.

But in the meantime, I already had another idea in my head - a more advanced product based on a new principle for constructing a thermonuclear charge. After testing the RDS-37, the next day in the evening I called my friend and colleague Yuri Nikolaevich Babaev to the shore of the Irtysh and said: "Yura, let's try to make something like this." And he agreed. We returned to Sarov and drew a charge diagram and proposed it. This product received index 49. I will not say what it is. Product 49 is similar to the RDS-37, but not in every way. They started laughing at us, it's all nonsense, you won't succeed. In short, they didn't support us because they didn't understand. Apparently, they decided so - well, young people come up with ideas, so be it. And it was like that for a long time.

What about us? Our KB-11 collaborated with Mstislav Keldysh and his Institute of Applied Mathematics in terms of calculations. By that time we had already worked well with his young guys. And they started counting. Everything was clear and understandable.

At the same time, our specialists - Zeldovich, Sakharov, Evgeniy Zababakhin, Lev Feoktistov - offered their own options, remaining within the framework of the RDS-37 scheme. I still cannot understand how such people, outstanding minds, instead of adapting a thermonuclear charge to a carrier, to a rocket, began to investigate whether it was possible to obtain even greater power? And they ran into the fact that the changes they proposed led to refusal. Zeldovich had three failures of thermonuclear units in a row during tests!

- What's the end result?

‘‘We began to insist on our proposal. We were supported by Igor Vasilievich Kurchatov. The test of product 49 took place on Soviet Army Day, February 23, 1958 at the test site on Novaya Zemlya. The success was very great. In 1958, several tests of products of different powers based on the 49th charge took place. It went into production, was put on rockets, and this was already the basis of our country’s thermonuclear weapons.

© RIA Novosti | Go to media bank

But after the tests in November 1958, our leadership stopped further experiments at the test sites; this was the first moratorium on nuclear tests. And here's the thing - Sakharov advocated abandoning testing. But at that time there was not a single combat thermonuclear charge in the country! But Sakharov insisted that we would hand over our charges to the military without testing.

Some time ago I began to leaf through the history of our tests and compare it with what Sakharov did then and what he later wrote about in his memoirs. So this is what turns out - he all the time opposed testing our new charges. What turns out to be an ugly thing is that he doesn't succeed with his charges, but we succeed, and he opposes our tests. How could this be done in those conditions of confrontation with the United States, when the Americans were testing their new thermonuclear charges? Can not understand. You don't even know what to think here.

One day, much later, I said to Yuliy Borisovich Khariton (scientific director of KB-11/VNIIEF - ed.): "Let's go to Sakharov and ask him questions, including whether it is possible to hand over the charges to the military in series without testing." We arrived and asked. He answers, you can pass without tests. I was the only one who spoke. Yuliy Borisovich was silent. But when we were leaving and getting dressed, suddenly Khariton said: "Andrei Dmitrievich, your position is the position of a player." They said goodbye and left. Three days later, Sakharov died.

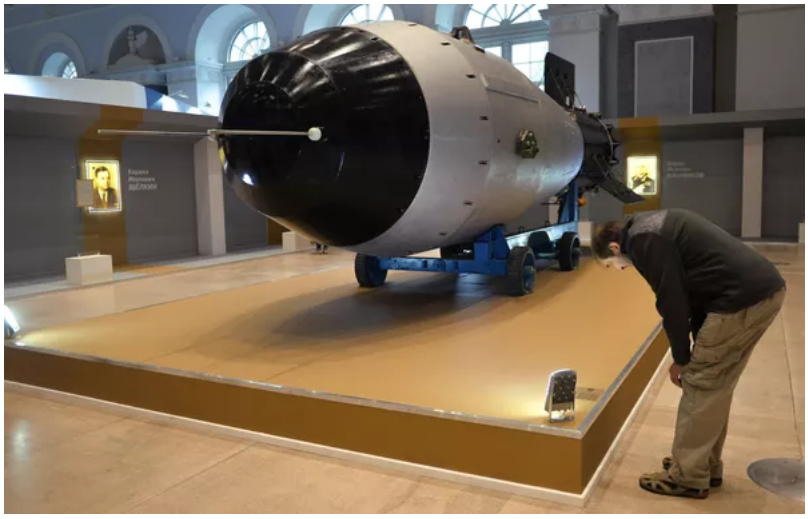
- The end of the 1950s, the beginning of the 1960s - the time was gradually approaching for the most powerful thermonuclear charge in history, which is now commonly called differently - "Tsar Bomba" or "Kuzka's Mother"...

— I also suggested this product under the index 602. I said to Khariton: "Yuliy Borisovich, let's make a 100-megaton charge. Maybe then the West will understand that it will be pointless for them to further increase their megatonnage." He agreed. But here, too, for safety reasons, we made a charge of half power, the stage from uranium-238 was replaced with lead.

We arrived at Novaya Zemlya. The test took place on October 30, 1961. We stood at the control panel where the countdown was going on. And at some point bang! - and radio communication stopped. This means that the explosion occurred successfully, its power was 58 megatons.

The explosion was very clean in terms of releasing radioactive fragments. The Americans and British were then surprised - how is it possible, such power and so few fragments - three percent? After that, everything that we young people proposed was put to the test. It's an amazing thing - it never happened that we were refused, there weren't even such conversations. Babaev and I involved a bunch of theorists, who immediately trained and got the desired results.

There was such a curious case. We decided to make a 40-megaton, but at the same time compact charge. Again, to avoid radioactive dirt, they removed the uranium stage and also replaced it with lead. The estimated power was thereby reduced to 20 megatons. On the day of the tests I was here in Sarov. I went to the market and returned home. A call from Yuli Borisovich Khariton is heard: "Yuri Alekseevich, come to Muzrukov's office immediately." This was the director of our center. I ask, how are things at the training ground? - "Come here." I'm coming. Picture: an empty office, with his hands clasped behind his back, Khariton walks quickly from corner to corner, frowning. I again: "Yuliy Borisovich, what happened?" - "Two megatons." - "Like two megatons? There should be 20 megatons." - "Well, that's how it happened." I think, Christmas trees, how can that be? But I thought of asking: "Juliy Borisovich, what method was used to determine the power?" - "By the rise of the cloud." Quite impudently I say: "By the rise of the cloud? Yuliy Borisovich, I went home. When there are real measurements, then it's a different matter."



© RIA Novosti / Vladimir Astapkovich | Go to media bank

- What happened?

- The cloud always rises to one height or another depending not only on the power of the explosion, but also on the state of the atmosphere. At that time, the air inversion was such that the cloud rose only 16 kilometers at twenty megatons. So, I came home and thought - what could have been there? Suddenly a new call: "Yura? We'll come to you now." This was David Abramovich Fishman (first deputy chief designer of KB-11/VNIIEF for the development of nuclear charges - ed.). He and Khariton arrived and said, yes, they measured the power using other methods and got twenty megatons.

- Do we understand correctly that perhaps the most important result of the "superbomb" test in 1961 was that the Americans almost immediately stopped the race to increase the megatonnage of their charges?

- Absolutely correct. The Americans realized that you can't scare us, but we will scare them. And they lowered the power in their tests. We could have done more, but what's the point?

- You noted a very high degree of purity of that charge. It was then that the direction of creating charges for peaceful, industrial explosions arose?

"From the very beginning we thought about how to use nuclear explosions for peaceful purposes. What needed to be done for this? Very much reduce, actually eliminate, the radioactivity of fragments resulting from an explosion. I took the initiative here too - how to make a clean charge, in the thermonuclear unit of which there are no fissile materials. And we designed such a charge. In parallel, our second nuclear center, the current VNIITF in Snezhinsk, was also working on the topic of industrial charges.

- It is known that with the help of the first peaceful nuclear explosion in 1965, Lake Chagan was created in Kazakhstan.

- This was done precisely with the help of our charge. It was blown up in the bed of the Chagan River. They made a funnel and it filled with water. Later a hydroelectric power station was built there.

- They wrote that you swam in this lake.

- And we swam, and there was nothing wrong. They lie when they say it's dangerous there. There are a huge number of fish in this lake.

- Yuri Alekseevich, scientists themselves consider nuclear and thermonuclear charges to be a set of original and even beautiful physical principles and engineering solutions. What would you compare the development of charges to? For example, with the work of an architect? After all, this can also be called real creativity?

— This is creativity, but of a completely different order than, for example, the work of an artist. The artist works primarily on emotions: here we will draw the brush this way, and here differently. This bush "screams" terribly, let's do something like this. And we have a calculation that is very complex and very responsible. If you miss something, nothing will work. And we did calculations in groups, worked in teams, where everyone understood each other. If something needs to be checked, they don't argue, but look and check. I'm used to working with such groups, I organize them and things go well.

- During the presidential elections of the Russian Academy of Sciences held in September, I remember your bright speech from the podium in support of the candidacy of Alexander Sergeev, who was later elected head of the RAS.

"I must say that Alexander Mikhailovich's performance, with his clear program and understanding of what to do and how to do it, was significantly superior to the performances of all other candidates. It was clear that he was a real leader.

© RIA Novosti / Evgeny Biyatov | Go to media bank

- According to Alexander Sergeev, which he has spoken about more than once, in Russia the scientific reserve accumulated in Soviet times for solving defense problems has now been practically exhausted. Do you think that the experience of our nuclear project, when specific tasks were clearly set and all the necessary resources - intellectual and material - were concentrated to solve them, can help improve the situation?

- Maybe. What is important from a defense point of view must be concentrated in institutions such as ours. I am in favor of developing in our nuclear center what is going worse in other places, but what, on the contrary, is going well here and what we could do.

- Can you give an example?

- Supercomputers. I believe that we, our institute, should really make these machines, because we are extremely interested in this. Not in the material gain - selling and putting money in your pocket, but in the opportunity to use this technique and know that it works for the cause. In order to correctly design a charge, we must first calculate it, especially since we cannot feel what is happening in the thermonuclear unit. And for this you need to have not only appropriate theoretical physicists, but also mathematicians and, of course, computer technology. This is what I have fought for all my life and am still fighting for.

At one time, we counted on Rheinmetalls - they were electromechanical and made great noise. Then our first lamp machines, Strela, appeared. This is exactly what the RDS-37 was designed for. And after the 49th product, our center received M-20 machines and then BESM - high-speed electronic calculating machines. BESM-3, BESM-4 and, finally, BESM-6. I want to emphasize that it was, of course, a supercomputer for its time, our first semiconductor-based computer, it allowed the Soviet Union to catch up with the Americans in computing power.

But then in our country we took the wrong path - we began to focus on Western computers, and as a result we fell behind. But in our nuclear center we work entirely on domestic machines.

- Yuri Alekseevich, what do young people need to succeed in science?

— Judging by my experience, I can say this: first of all, you need to read a lot. Nowadays they read little, and they read mostly nonsense. But how can we instill in young people the need for good literature describing science and scientific research? Of course, you need to read popular science books. For example, "Microbe Hunters" and "Are They Worth Living?" Paul de Cruy. These are the most curious, magnificent things. Science fiction - I read it with great pleasure, I love science fiction, I re-read Stanislaw Lem. I highly recommend reading books from the “Life of Remarkable People” series.

I have been collecting books since childhood, I have a large library. When our family returned to Leningrad in 1944 after the siege was lifted, one of the greatest impressions on me was made by the book ruins against the backdrop of destroyed houses. Mountains of books, they were sold, and I bought and bought books on science. It is interesting that even then the owners of some books were found.

Once, even before the war, I bought a small book about a conference on atomic nuclear physics. The author was Yuli Khariton. And that’s how it happened - we then worked together for several decades. One day I told him that I had such a book. But for some reason Khariton didn’t have it, apparently it was lost. And he asked to give it. Of course, I couldn’t refuse Yuli Borisovich.

5 0 0 0 0 0